10/521333
DT12 Rec'd PCT/PTO 18 JAN 2005

CLAIMS

1. (Amended) A copper alloy for welding electrodes, characterized in that the copper alloy contains, as a second element that does not dissolve or scarcely dissolves in copper in a solid solution state at room temperature, any of chromium (Cr), zirconium (Zr), beryllium (Be), titanium (Ti) and boron (B), the addition ratios of the second elements being Cr: 0.1 to 1.4 wt%, Zr: 0.15 to 0.5 wt%, Be: 0.1 to 3.0 wt%, Ti: 0.1 to 6.0 wt%, B: 0.01 to 0.5 wt%, in that this alloy has an average crystal grain size of not more than 20 μm, in that the second elements precipitates among crystal grains, and in that the copper alloy has a hardness of not less than 30 HRB, an electrical conductivity of not less than 85 IACS%, and a thermal conductivity of not less than 350 W/(m·K).

2. (Delete)

3. (Delete)

4. (Delete)

5. (Amended) A method of manufacturing a copper alloy for welding electrodes, characterized in that the method comprises enabling any of chromium (Cr), zirconium (Zr), beryllium (Be), titanium (Ti) and boron (B) to dissolve in a solid solution in a base-material metal (Cu) as a second element that does not dissolve or scarcely dissolves in copper in a solid solution state at room temperature, the addition ratios of the second elements being Cr: 0.1 to 1.4 wt%, Zr: 0.15 to 0.5 wt%, Be: 0.1 to 3.0 wt%, Ti: 0.1 to 6.0 wt%, B: 0.01 to 0.5 wt%, subsequently achieving crystal grain refinement by applying a strain equivalent to an elongation of not less than 200% to this material, and subjecting this material to aging treatment simultaneously with or after the application of this strain, thereby to promote precipitation of the second element among crystal grains.

6. (Delete)

7. (Amended) The method of manufacturing a copper alloy for welding electrodes according to claim 5, characterized in that means for applying a strain to the material is any of extrusion, drawing, shearing, rolling and forging.

8. (Amended) The method of manufacturing a copper alloy for welding electrodes according to claim 7, characterized in that conditions for the extrusion are such that lateral extrusion is performed at a material temperature of 400 to 1,000°C, a die temperature of 400 to 500°C, and an extrusion speed of 0.5 to 2.0 mm/sec.

9. (Amended) The method of manufacturing a copper alloy for welding electrodes according to any of claims 5, 7 or 8, characterized in that before a strain is applied to the material, the material is subjected to aging treatment beforehand.

10. (Amended) A composite copper material for welding electrodes, characterized in that an alumina powder or a titanium boride powder is dispersed in a copper matrix in an amount of 0.1 to 5.0 wt% and in that this composite copper material has a hardness of not less than 30 HRB, an electrical conductivity of not less than 85 IACS%, and a thermal conductivity of not less than 350 W/(m·K).

11. (Delete)

12. (Delete)

13. (Delete)

14. (Amended) A method of manufacturing a composite copper material that comprises mixing a copper powder and a ceramic powder together, thereby to form a mixed powder as a primary shaped body, and applying a strain to this primary shaped body, thereby to form a secondary shaped body in which base material and ceramic particles are combined together with refined particle sizes, characterized in that the average particle size of the ceramic powder is 0.3 to 10 μm, in that a strain applied to the primary shaped body is equivalent to an elongation of not less than 200%, in that the means for applying a strain is extrusion that is performed at a material temperature of not less than 400°C but not more than 1,000°C and a die temperature

of not less than 400°C but not more than 500°C, in that the average particle size of a base material of the secondary shaped body to be obtained is not more than 20 μm, and in that the average particle size of ceramic particles is not more than 500 nm.

15. (Delete)

16. The method of manufacturing a composite copper material according to claim 14, characterized in that the primary shaped body is obtained by green compacting or by filling the mixed powder in a tube.

17. (Delete)

18. (Amended) A method of manufacturing a composite copper material in which titanium boride is dispersed in a copper matrix, characterized in that the method comprises the steps [1] to [3] below:

[1] the step of mixing a copper powder, a titanium powder and a boron powder together, thereby to form a primary shaped body;

[2] the step of applying thermal energy to the primary shaped body, thereby causing the titanium powder and the boron powder to react with each other in order to form titanium boride in a copper matrix; and

[3] the step of applying a strain to the primary shaped body in which the titanium boride is formed by plastically deforming the primary shaped body, thereby to form a secondary shaped body.

19. The method of manufacturing a composite copper material according to claim 18, characterized in that the secondary shaped body is subjected to heat treatment in the same step as the step of applying a strain by plastic deformation or a step following this step.

20. The method of manufacturing a composite copper material according to claim 18 or 19, characterized in that the plastic deformation involves applying a strain equivalent to an elongation of not less than 200%.

21. The method of manufacturing a composite copper material according to any of claims 18 to 20, characterized in that the plastic deformation is extrusion that is performed at a material temperature of not less than 400°C but not more than 1000°C.

22. The method of manufacturing a composite copper material according to any of claims 18 to 20, characterized in that the plastic deformation is extrusion that is performed at a die temperature of not less than 400°C but not more than 500°C.

23. The method of manufacturing a composite copper material according to any of claims 18 to 22, characterized in that the primary shaped body is obtained by green compacting or by filling a mixed powder in a tube.

24. The method of manufacturing a composite copper material according to any of claims 18 to 23, characterized in that the average particle size of the ceramic powder is 0.3 to 10 μm in that the average particle size of a base material of the secondary shaped body to be obtained is not more than 20μm, and in that the average particle size of titanium boride particles is not more than 500 nm.